THE PETROLEUM INDUSTRY IN INDIANA IN 1897.

BY W. S. BLATCHLEY.

With the exception of a small output in Vigo County, all the petroleum produced in Indiana is yielded by the Trenton limestone of the Lower Silurian formation. The main field is very probably a continuation westward of that of Lima, Ohio, though as yet the connecting area between the two has not been located. This field, comprising about 400 square miles, lies northeast of the center of the State, in portions of Adams, Jay, Wells, Blackford, Grant and Huntington counties. Outside of this area, oil in commercial quantities was being produced on January 1st, 1898, near Peru, Miami County; Walton, Cass County; Rich Valley, Wabash County; Alexandria, Madison County; Washington Township, Delaware County, and Broad Ripple, Marion County. All of these minor productive pools were located in 1897, except the one at Broad Ripple, where one or two bores produced oil the year before. As predicted in my former reports, the main field is thus slowly but surely extending its borders to the south and west, and will eventually cover all, or the greater portion of the area now producing natural gas.

Location of Oil Producing Areas.

The petroleum of the Trenton limestone was formed in that rock many thousands of years ago, by the slow decomposition or destructive distillation of myriads of animals and plants which existed in the Silurian seas at the time the sediment of which the limestone was formed was being deposited. Those animals and plants were buried in vast numbers in that sediment, and by the waters above and the ooze around them shut off from the free oxygen of the air, and the decay ordinarily undergone by dead organisms was thereby prevented. It is a well known fact that if wood, coal or the body of any animal be placed in an air-tight retort and heated, a distillation will occur, and the object will be changed to gaseous, oily and solid matters. In the absence of heat a very long period of time will bring about the same results. By this is meant the process of "slow destructive distillation" above mentioned.

Origin of Petroleum.

The Trenton limestone, when first formed, was a pure calcium carbonate, or carbonate of lime. In the course of time certain areas of the sea bottom, covered with the lime carbonate, were slowly raised

until they became higher than the others, and formed shallow basins, lagoons or bays. Some of these raised portions covered very large areas. Others were isolated or separated from the main area sometimes by a distance of 20 to 30 miles. The outline of all was irregular, with many indentations along the margins. In these more shallow portions of the Silurian seas the water became in time very briny and caused a chemical change in the rock. To the lime carbonate was added some magnesia from the brine, and a magnesia-lime carbonate called "dolomite" resulted. Wherever this change took place—which was only in the shallow, briny areas noted—the resulting dolomite was porous. This porous condition was due to the fact that the new crystals of dolomite were smaller than, and never entirely filled the spaces occupied by, the older crystals of lime carbonate.

Formation of Porous Layers in Trenton Limestone

Trenton limestone underlies the whole State of Indiana at depths varying from 348 feet below the surface at Lawrenceburg to 1,933 feet below at Auburn and 2,300 feet below at Evansville. Only a small proportion of this underlying Trenton was ever changed into dolomite or porous rock, and only in the porous areas are gas and oil found. There is absolutely no method of telling where the limestone is porous and where it is not, except by putting down a bore.

Trenton Limestone in Indiana.

The Trenton in Indiana varies in known thickness from 470 to 586 feet, and the porous portion is found only near its upper part. It is useless to drill into it more than 70 feet, since, of the eight thousand and more bores which have been put down in the State no oil or gas has been found below that depth.

The surface of the Trenton limestone is not level as many people suppose, but is a series of alternating arches and depressions or ridges and valleys. The arches or domes are like inverted troughs and vary much in width and area, as do also the depressions between them.

Wherever gas and oil occur they will be found in a porous stratum in one of the arches or anticlines as they are called. If a bore happens to be put down and strikes a depression or syncline between the arches, salt water will invariably be found. If both gas and oil are present in a certain area, and the bore strikes the flank or side of the arch, oil will result. If the bore strikes the crest or dome of the arch, gas will flow. The cause of this is simple, being due to the arrangement of the three fluids according to their relative weights—the lighter gas having in the past risen to the highest portion of the porous limestone; the oil, being heavier than gas and lighter than water, having been stored in the intermediate and the heavier salt water in the lower level. The volume

Oil in Arches or Anticlines.

of gas and oil accumulated in any field, will depend, therefore, upon the area and height of the anticline, and upon the relative thickness and degree of porosity of the dolomitic portion of the Trenton limestone.

Where a bore for petroleum has resulted in a good producing well, the level of the surface of the Trenton rock below tide should be carefully ascertained. This can be done only by running a transit level from the nearest point where the surface level is known, usually on a railway, to the surface of the bore. By subtracting the surface level of the bore from the depth at which Trenton limestone is first struck, the surface level of the latter will be obtained. In but few places in the State is Trenton found above sea level. Where so found the depth to Trenton will be less than the surface level of the bore, and should be subtracted accordingly.

Necessity of Accurate Surface Levels.

The location of the first dozen or more wells in any area a mile or two square must of necessity be largely a matter of guess-work, but if the surface level of the Trenton in each bore, productive or dry, be carefully ascertained, the trend of the anticline and the approximate limits of the field or pool can be soon determined. Too much guess-work concerning the surface level of the spot on which the well is located has been done in the past. In a broken country it is difficult for any man to guess approximately at the relative levels of two points a quarter of a mile apart, and the new level should always be ascertained with instruments. Of course the surface level of the bore has nothing to do with the absolute height or surface level of the Trenton, or the absence or presence of the petroleum, but it has a great deal to do with the accurate *determination* of the surface level of the Trenton and therefore with the location of future wells. If a few thousand dollars had been spent in Indiana in past days in the careful determination of surface levels, it would have saved a few hundred thousand which have been sunk in dry holes.

At the main points at which petroleum is produced in Indiana, the surface level of the Trenton lies below sea level as follows:

Alexandria	**45 feet.**
Broad Ripple	**105 feet.**
Geneva	**164 feet.**
Keystone	**128 feet.**
Montpelier	**107 feet.**
Peru	**210 feet.**
Rich Valley	**208 feet.**
Van Buren	**138 feet.**
Walton, Cass Co	**171 feet.**

A fallacy which is possessed by many would-be operators is, that oil fields or pools run in lines, and that one field is connected with all others, the oil flowing from one to the other, through a continuous strip of porous rock. This may in part be true in the Pennsylvania oil regions, but it is wholly untrue in the Trenton limestone area of Ohio and Indiana. While all the so-called "pools" of that area are found in the Trenton formation, they are not necessarily connected, nor do they run in lines. A pool may be of any shape, and may lie in any direction from any other pool. Its boundaries may be straight or sinuous; its area one square yard or one thousand square miles. If the conditions necessary for the storing of petroleum, namely a porous reservoir, located in a dome or anticline of the Trenton limestone, with an impervious cover above it and a water pressure below it, have been present in the past, the oil will very likely be found, whatever the shape, size or relative location as to other similar reservoirs. The operator can only sink his drill; he has no way of knowing before-hand what the result will be. He may pierce the center of the reservoir and get a 500-barrel well; he may strike near its outer rim and get a ten-barrel well—he may miss it altogether and get a dry hole. One thing he can rely upon if he strikes a productive well, and that is, that he is drawing upon a stored product which is not now being formed in the rock from which it is drawn, and that, therefore, he must eventually exhaust the stock from the immediate vicinity of his bore.

Pools Not Necessarily Connected.

More or less salt water is found in all portions of the main field. A difference of only six to ten feet in elevation or depression of the surface of the Trenton defines oil and salt-water territory. Some of the best wells pump a large amount of salt water with the oil. The water seems to keep the pores of the oil rock free from paraffine and other clogging materials, and a well producing four to ten barrels of water a day is preferred by many operators to one that produces oil alone.

Salt Water in Indiana Field

Throughout the Indiana field an eight or ten inch drive pipe is forced down through the drift to the Niagara limestone. The salt water usually found in the Niagara is cased off by an iron tube 5⅝ or 6¼ inches in diameter, which reaches to the soft blue Hudson River limestone underlying the Niagara. This second limestone and the Utica shale beneath it contain no water. The Trenton is everywhere overlain with the soft, dark colored Utica shale which forms an impervious cover through which neither gas nor oil can escape. From the bottom of this shale the drill passes at once into hard limestone. In the main

The Indiana Field Cheaply Operated.

field the first "pay streak" is found at from 15 to 25 feet in the Trenton; and usually a "second pay" 10 to 12 feet lower down. A few feet below the second porous stratum salt water is usually found. The driller aims to go as near this as he can without tapping the stratum in which it occurs.

For a number of reasons a lease in the Indiana field can be operated as cheaply as any in the eastern United States. Chief among these are the following:

(a) The wells are comparatively shallow, the Trenton limestone in most instances being struck at less than 1,000 feet. (b) It is seldom that more than 150 feet of drive pipe and 400 feet of casing are necessary. (c) On account of a comparatively level surface a large number of wells can be connected to and pumped with one power. (d) Gas for fuel or for running gas engines is usually plentiful. (e) Transportation facilities are excellent, a system of pipe lines permeating all parts of the main field.

But few extensions of any importance were made in the main Indiana oil field in 1897. The prevailing low price of petroleum prevented operations in territory which had been fairly well tested. The "wildcatters" gave most of their attention to the pools at Alexandria and Peru, where they hoped to strike something better than the main field promised. Moreover, all of the most promising prospective territory within or near the lines shown on last season's map was under lease, and the operators only aimed to protect property lines, leaving active drilling for the future when the price of the product shall have raised. In Jay County some good wells were drilled in the south half of section 7, the northeast quarter of section 8 and the north half of section 18 (24 north, 13 east), in territory which had not before been tested.

New Developments in the Main Field.

The Diamond Oil Company has had remarkable success with its lease on the A. H. Myers farm in section 30 (24 north, 12 east), Harrison Township, Blackford County. Of three wells put down in 1896 and nine in 1897, all have been good producers, starting out from 60 to 300 barrels per day. Their total production for the year was 75,000 barrels on the 184 acres, proving it one of the best leases in the main field. The Trenton is found at depths varying from 934 to 972 feet. Numerous bores have been put down on all sides of this lease, but they have for the most part proven dry holes or small producers.

No developments of importance were made in Adams County. In Wells County several good wells were located on the W. Pouless farm, in section 6, Jackson Township, which had before been undrilled. It is estimated by a conservative operator that the old wells of the county have had an average decline of 40 per cent. in output within the year.

In Grant County the only new developments have been in the north halves of sections 2 and 3, Van Buren Township, where some fair wells were completed by the Ziegler Oil Company.

In Huntington County a number of good wells were completed in the southwest corner of Jefferson Township, but the lines of the productive area were unchanged. Sections 27 to 34, inclusive, in Salamonie Township, will doubtless be found to be paying territory in the future—though one or two test bores have developed only salt water.

STATISTICS OF THE OIL INDUSTRY IN INDIANA.

The following table gives the production of petroleum in the United States from 1859 to 1896, inclusive, together with the average yearly prices per barrel:

Production of Crude Petroleum in the United States from 1859 to 1896 (Barrels).

YEAR.	Pennsylvania and New York.	Ohio.	West Virginia.	Colorado.	California.	Indiana.	Kentucky and Tennessee.	Illinois.	Kansas.	Texas.	Missouri.	Indian Territory.	Wyoming.	Total United States.	Average Yearly Prices per Barrel.
1859....	2,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000	.....
1860....	500,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	500,000	$9 59
1861....	2,113,609	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,113,609	49
1862....	3,056,690	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	a3,056,690	1 05
1863....	2,611,309	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,611,309	3 15
1864....	2,116,109	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,116,109	8 06
1865....	2,497,700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,497,700	6 59
1866....	3,597,700	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,597,700	3 74
1867	3,347,300	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,347,300	2 41
1868	3,646,117	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,646,117	3 62½
1869....	4,215,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,215,000	5 63¾
1870....	5,260,745	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,260,745	3 86
1871....	5,205,234	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,205,234	4 34
1872....	6,293,194	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,293,194	3 64
1873....	9,893,786	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9,893,786	1 87
1874....	10,926,945	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,926,945	1 15
1875....	8,787,514	b200,000	b3,000,000	.....	b175,000	.....	.....	.....	.....	.....	.....	.....	.....	b12,162,514	1 36
1876....	8,968,906	31,763	120,000	.....	12,000	.....	.....	.....	.....	.....	.....	.....	.....	9,132,669	2 56¼
1877....	13,135,475	29,888	172,000	.....	13,000	.....	.....	.....	.....	.....	.....	.....	.....	13,350,363	2 42
1878....	15,163,462	38,179	180,000	.....	15,227	.....	.....	.....	.....	.....	.....	.....	.....	15,396,868	1 19
1879....	19,685,176	29,112	180,000	.....	19,858	.....	.....	.....	.....	.....	.....	.....	.....	19,914,146	85⅞
1880....	26,027,631	38,940	179,000	.....	40,552	.....	.....	.....	.....	.....	.....	.....	.....	26,286,123	94½
1881....	27,376,509	33,867	151,000	.....	99,862	.....	.....	.....	.....	.....	.....	.....	.....	27,661,238	85⅞
1882....	30,053,500	39,761	128,000	.....	128,636	.....	c160,933	.....	.....	.....	.....	.....	.....	30,510,830	78⅛
1883....	23,128,389	47,632	126,000	.....	142,857	.....	4,755	.....	.....	.....	.....	.....	.....	23,449,633	1 05⅜
1884....	23,772,209	90,081	90,000	.....	262,000	.....	4,148	.....	.....	.....	.....	.....	.....	24,218,438	83½
1885....	20,776,041	650,000	91,000	.....	325,000	.....	5,164	.....	.....	.....	.....	.....	.....	21,847,205	87⅞
1886....	25,798,000	1,782,970	102,000	.....	377,145	.....	4,726	.....	.....	.....	.....	.....	.....	28,064,841	71¼
1887....	22,356,193	5,018,015	145,000	76,295	678,572	.....	4,791	.....	.....	.....	.....	.....	.....	28,278,866	66¾
1888....	16,488,668	10,010,868	119,448	297,612	690,333	.....	5,096	.....	.....	.....	.....	.....	.....	27,612,025	87⅝
1889....	21,487,435	12,471,466	544,113	316,476	303,220	33,375	5,400	1,460	500	48	20	.....	.....	35,163,513	94½
1890....	28,458,208	16,124,656	492,578	368,842	307,360	63,496	6,000	.....	1,200	54	278	.....	.....	45,822,672	86¾
1891....	33,009,236	17,740,301	2,406,218	665,482	323,600	136,634	9,000	.....	1,400	54	25	30	.....	54,291,980	67
1892....	28,422,377	16,362,921	3,810,086	824,000	385,049	698,068	6,500	.....	.....	45	10	80	.....	50,509,136	55⅝
1893....	20,314,513	16,249,769	8,445,412	594,390	470,179	2,335,293	3,000	.....	.....	50	50	10	.....	48,412,666	64
1894....	19,019,990	16,792,154	8,587,624	515,746	705,969	3,688,666	1,500	300	40,000	60	8	130	2,369	49,344,516	72
1895....	19,144,390	19,545,233	8,120,125	529,482	1,208,482	4,386,132	1,500	200	44,340	50	10	37	3,455	52,983,526	1 09
1896....	20,584,421	23,941,169	10,019,770	361,450	1,252,777	4,680,732	1,680	250	113,571	1,460	43	170	2,878	60,960,361	96
Total.	537,241,681	157,284,942	47,199,374	4,458,525	7,936,678	16,022,396	224,193	2,210	201,101	1,811	444	457	8,702	770,582,514	.....

a In addition to this amount, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 from the Pennsylvania fields; also a large amount from West Virginia and Tennessee. b Including all production prior to 1876 in Ohio, West Virginia and California. c This includes all the petroleum produced in Kentucky and Tennessee prior to 1883.

From the above table it will be learned that the production of petroleum in Indiana gradually increased from 33,375 barrels in 1889, when the wells at Terre Haute first began yielding, to 4,680,732 barrels in 1896. In 1897, the production, for the first time, fell below that of the preceding year, the loss being 327,594 barrels, or very nearly 7 per cent. This decrease was mainly due to the prevailing low price of the product, which brought about an inactivity in drilling. As already noted, the production of the old wells in the main field fell off about one-third, and the total production for the year would have been much less had it not been for the new developments at Peru, Alexandria and other points.

In the following table is shown the total production in Indiana by months from 1891 to 1897, inclusive. The largest production in any one month is seen to have been in July, 1895, when 434,376 barrels were produced.

TOTAL PRODUCTION OF PETROLEUM IN INDIANA FROM 1891 TO 1897, BY MONTHS.

[Barrels.]

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
January	6,171	15,841	111,824	259,000	300,568	365,582	290,746
February	5,981	18,946	96,025	232,107	230,559	341,743	309,922
March	5,159	24,794	134,549	282,376	310,303	386,586	341,961
April	4,973	26,184	146,493	287,330	352,077	395,032	328,779
May	5,757	31,033	136,939	321,502	397,001	417,963	340,023
June	8,136	40,888	209,616	333,479	403,569	434,167	369,803
July	10,809	49,203	221,666	327,349	434,376	422,968	375,249
August	11,603	56,109	248,353	345,031	420,132	407,238	371,921
September	16,500	66,034	245,615	319,588	409,169	415,665	362,528
October	19,029	95,699	252,568	339,424	393,153	394,283	408,179
November	20,801	129,270	245,807	304,030	373,789	337,331	430,958
December	21,715	144,067	236,038	337,450	361,436	362,164	423,069
Total	136,634	698,068	2,335,293	3,688,666	4,386,132	4,680,732	4,353,138

It will be noted that the production in each of the winter months is less than in those of spring or summer. This is usually the case, there being, during the cold season, fewer wells drilled in and a smaller yield from those already finished. The shipments are greater than the production in winter and the price usually rises a few cents per barrel.

In the following table will be found a statement of the production of petroleum in Indiana from 1889 to 1897, inclusive:

PRODUCTION OF PETROLEUM IN INDIANA FROM 1889 TO 1897.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Total production (barrels of 42 gallons)	33,375	63,496	136,634	698,068	2,335,293	3,688,666	4,386,132	4,680,732	4,353,138
Total value at wells of all oils produced, excluding pipage	$10,881	$32,462	$54,787	$260,620	$1,050,882	$1,774,260	$2,807,124	$2,954,411	$1,871,849
Value per barrel	$0.32⅔	$0.51⅛	$0.40	$0.37	$0.45	$0.48	$0.64	$0.63	$0.43

From the following table may be learned the number of wells put down in Indiana for oil in any month since June, 1891:

NUMBER OF WELLS COMPLETED IN THE INDIANA OIL FIELDS FROM 1891 TO 1897, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891							6	6	15	15	15	8	65
1892	11	13	18	13	17	19	17	30	25	52	33	47	295
1893	20	30	31	36	45	47	47	55	27	72	56	76	542
1894	90	103	103	80	110	107	84	123	100	107	97	85	1,189
1895	61	45	81	111	122	153	132	140	129	106	102	85	1,267
1896	76	90	86	136	148	151	113	121	70	57	66	66	1,180
1897	41	35	40	47	49	52	61	45	55	89	117	54	685
Total													5,223

This table shows that there was less activity in oil operations in Indiana in 1897 than during any year since 1893. On January 1st, 1898, there were 3,648 wells producing oil in the State, so that 1,575 of those completed had either proven dry holes or had ceased to yield oil in sufficient quantity to pay for pumping.

The following table gives the

TOTAL NUMBER OF DRY HOLES DRILLED IN INDIANA OIL FIELDS FROM 1891 TO 1897, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891							0	2	5	4	3	1	15
1892	2	6	6	2	3	4	2	3	3	18	6	21	76
1893	7	10	10	6	14	6	11	9	5	14	10	9	111
1894	19	14	24	14	13	13	9	21	15	14	8	17	181
1895	7	4	13	16	22	20	15	23	12	12	9	13	166
1896	10	13	6	28	26	20	14	19	4	4	6	8	158
1897	8	9	7	12	5	16	11	9	16	11	18	8	130

From the following table may be learned the

NUMBER OF PRODUCING WELLS AND NUMBER OF DRY HOLES DRILLED IN EACH OF THE OIL PRODUCING COUNTIES OF INDIANA IN 1897.

COUNTY.	Producing Wells.	Dry Holes.	Total.
Wells	161	20	181
Blackford	47	23	70
Jay	34	19	53
Adams	29	13	42
Grant	43	1	44
Huntington	29	1	30
Madison	32	34	66
Miami	166	12	178
Marion	11	5	16
Delaware	3	2	5
Total	555	130	685
Total, 1896	1,022	158	1,180
Decrease	467	28	495

One feature of the oil industry which has come into common use, and which should be abandoned, is that of giving the initial output of a well rather than its settled production after 30 or 60 days. Because a well starts out at 100 or 250 barrels a day is no sign that its total production will be a large one. In general it may be said that a 50-barrel well will be down to ten barrels in two months, and to five barrels in a year. A well that has an initial production of 50 barrels is a fair average well for the entire Indiana field, the average production of which is about 3.7 barrels per well per day. A well that starts off at 150 to 250 barrels gets down to the average in time, the only difference being that the oil bearing stratum which the bore has pierced is a little more porous than in the one yielding 50 barrels.

The following table shows the

INITIAL DAILY PRODUCTION OF NEW WELLS IN THE INDIANA OIL FIELDS FROM 1891 TO 1897, BY MONTHS.

[Barrels.]

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
January	.....	342	1,020	2,361	2,132	1,557	730
February	.....	250	913	2,935	1,413	1,875	1,000
March	.....	289	2,805	3,395	2,504	2,090	1,000
April	.....	316	4,135	3,175	3,473	2,825	800
May	.....	505	3,155	4,450	3,035	3,149	1,295
June	.....	545	5,595	4,886	4,923	3,115	900
July	253	595	3,880	3,530	3,067	2,332	1,780
August	135	1,295	4,184	3,435	2 760	2,650	850
September	875	2,145	2,055	3,149	3,175	1,700	2,010
October	330	4,155	3,442	3,455	2,651	1,515	4,080
November	390	3,050	2,305	3,323	2,560	1,400	3,790
December	175	3,160	2,968	2,654	2,025	1,100	1,045
Average	360	1,387	3,038	3,396	2,810	2,109	1,607

THE ALEXANDRIA OIL FIELD.

On April 23d, 1897, a bore put down on the N. Carver farm, northeast quarter of section 17 (21 north, 8 east), two miles northeast of Alexandria, Madison County, developed a large amount of petroleum. It was a wild-cat bore put down by the Northern Lima Oil Company, and when first drilled in showed but little signs of oil. The Trenton limestone was struck at 890 feet and was pierced 100 feet, the drill passing through two streaks of porous rock with 28 feet of hard, nonporous material between them. The showing of oil was enough to cause the company to shoot the well on the date mentioned, when it at once began to flow about 250 barrels per day. Owing to a lack of tankage and pipe line facilities much of the first week's flow was wasted, but the Buckeye Pipe Line soon made connection with their loading rack at Alexandria, and took care of the product.

The drilling in of such a well awakened the lethargy which for a number of months had enthralled the oil operators throughout the Lima—Indiana field, and hundreds of them flocked to Alexandria and sought leases in the prospective territory. A number of bores were soon started, nine of which were completed in May. Of these, three yielded gas only, and the remaining six had a combined initial output of but 245 barrels of petroleum.

One of these wells, located on the Decker farm, about 20 rods west of the Carver well, showed but a trace of oil, but gave off a large amount of gas which for a time was allowed to escape. This opened up the great question of the waste of gas from oil wells, which has since been the subject of much contention between oil operators and the consumers of natural gas. This question is fully discussed by the State Gas Supervisor, Mr. J. C. Leach, in another part of the present volume.

In June, 11 additional wells were drilled in, but three of which yielded oil, and the remainder gas. One of the oil wells was located on the S. M. Peck farm, in the southwest quarter of section 23 (21 north, 8 east), about two and one-half miles southeast of the Carver well. It started out at 100 barrels, and on September 25th was producing about 60 barrels of oil and wasting 2,000,000 cubic feet of gas daily. Four bores have since been drilled on the same farm, one of which started at 25 barrels and another at 30, the other two being dry.

A second one of the wells, which was finished in June, created much excitement, for the reason of its location within the corporate limits of Alexandria, on a lot in the Hillside Addition. It had an in-

itial output of 50 barrels daily, but by mid-September was down to 10 barrels and a small flow of gas. This immediately started a town lot boom in that section of the city and a number of wells were drilled in, the most productive of which, known as the Stillwell No. 1, was finished July 1st, starting at 150 barrels, with a large accompanying waste of gas.

During July 12 bores were completed in the Alexandria field, five of which were dry. The seven producing wells had an initial output of 605 barrels, 400 of which were yielded by a single well on the W. P. Blake farm, east half of northwest quarter of section 16 (21 north, 8 east). This was one-third mile east of the Carver No. 1, and was the best well drilled near Alexandria in 1897. The Trenton limestone was found at 918 feet. Four other bores on the same lease started at 150, 125, 10 and 100 barrels, respectively. The first two wells soon began to yield large quantities of salt water, and by September 25th the No. 1 was producing 65 barrels of oil and wasting 1,000,000 cubic feet of gas daily.

Bores which were dry or yielded gas only were drilled on the W. P. Perry farm, one mile northwest of Alexandria, where the Trenton was found at 880 feet below the surface; also on the M. E. Tomlinson farm, one mile north; on the Wm. Carver farm, one mile west; on the Sharp farm, four miles southwest; on the Mary Nicson farm, one mile southwest, and on the Thomas Baxter farm, two and a half miles southeast, of Alexandria. Two bores, which furnished gas only, were also sunk on the Rosebaum and Vincent farms, near Summitville. These non-productive bores stopped the growth of the field to the north, west and south. With the exception of three or four, all bores sunk within the limits of the town yielded much gas and little oil, and but eight of them produced oil at all. Several bores which were put down between these town-lot wells and the Blake-Carver pool proved dry, and developments in the former locality came to a close.

During August and September 23 bores were finished, ten of which were dry, and the 13 producing had a combined output of only 425 barrels. The interest of operators was about this time transferred to the field at Peru, and during the last three months of the year but little drilling was done, and this only east and northeast of the original Carver well. This well, by September 25th, was yielding gas only, and a second bore put down on the same lease in December proved dry.

While the results in the Alexandria field have, up to the present, proven unsatisfactory, there is little doubt but that in the future its limits will be extended to the northeast, until it is connected with the main Indiana field. It would be far better, however, to postpone

drilling within the limits of the gas-producing territory until the supply of gas has been practically exhausted. The oil can be held in store and will not be wasted while the gas is being drawn off. It is worse than folly to waste the one while trying to secure the other. Wherever the two are found in conjunction, separators should be used and the gas piped to some main where it can be utilized. Such separators are on the market and their utility has been proven. Laws should be enacted giving the Gas Supervisor the right to shut off all wells where either of the two products is being wasted. By such means only can these two fuels be properly conserved and made to be of the greatest and most lasting utility to the people of the State.

The following are the statistics of the Alexandria field to January 1st, 1898. They were in part furnished by Mr. Leach, who has been actively engaged since June 1st in trying to shut off the waste of gas:

STATISTICS OF THE ALEXANDRIA OIL FIELD FOR 1897.

	Wells Drilled.	*Dry Holes or Gas Wells.*	*Production by Months.*
April	1	0	678 barrels.
May	8	3	1,171 barrels.
June	11	8	2,053 barrels.
July	12	5	6,487 barrels.
August	11	3	16,528 barrels.
September	12	7	11,072 barrels.
October	6	4	11,970 barrels.
November	3	2	10,326 barrels.
December	3	2	11,482 barrels.
Total	67	34	71,767 barrels.

Wells drilled for oil in Madison County in 1897	67
Wells that have produced oil in commercial quantities	29
Wells that produce gas in commercial quantities	35
Dry holes	8
Wells producing oil January 1, 1898	21
Wells allowing escape of gas January 1, 1898	17
Am't of gas wasting daily, Jan. 1 (estimate)	20,000,000 cubic ft.
Daily oil production, Jan. 1	400 barrels.
Average production per well, Jan. 1	18 barrels.

Seven miles northeast of Alexandria, in section 36 (22 north, 8 east), Washington Township, Delaware County, several bores were put down in the fall of 1897, two of which yielded oil in commercial quantities. The first of these, on the Wm. Broyles farm, struck the Trenton limestone at 940 feet, the first pay streak at 1,010 and the second at 1,045 feet. The well was not shot, and started with a flow of 50

barrels. The second, on the Robert Livingston farm, three-quarters of a mile southwest, started at 150 barrels, after striking the Trenton at 937 feet. On the first of January Mr. Leach reported that the two wells were producing daily 125 barrels of oil and 3,000,000 cubic feet of gas; the latter being allowed to escape. On the Karus farm, near Matthews, five miles northeast of the Broyles well, a bore put down in December resulted in a dry hole; as did also one on the Vickery farm, a mile east of the Broyles well.

THE PERU OIL FIELD.

The greatest development of the Petroleum Industry in Indiana in 1897 was in the immediate vicinity of Peru, Miami County, about 35 miles northwest of the western end of the main field. Two hundred and twenty-nine wells were put down in this new field between August 15th and January 1st, and of these 178 have proven productive of petroleum in commercial quantities.

It had long been supposed that Peru lay outside of both the oil and gas areas of the State. This supposition was based on the fact that three wells were put down in the vicinity of that city in 1888—all of which yielded salt water, and but one of which showed signs of oil. The first of these was located on the E. A. Bearss land in the southeast quarter of the northeast quarter of section 28 (27 north, 4 east), in the north part of the city, and less than one-third of a mile due east of some of the most productive wells of the present season. The record of that well as given by S. S. Gorby* was as follows:

Alluvium—river drift	36 feet.
Niagara limestone	385 feet.
Hudson River and Utica	454 feet.
Top of Trenton	875 feet.
Total depth	905 feet.
Surface above sea level	657 feet.
Top of Trenton below sea level	218 feet.

In this well a small quantity of oil was found five feet below the top of the Trenton, and at 25 feet in Trenton salt water in abundance was struck.

The second bore was put down on the J. F. Miller farm in the southeast quarter of section 34 (27 north, 4 east)—south of the Wabash River and about one and three-quarter miles southeast of well No. 1. Its surface was 700 feet above sea level, and Trenton was struck at a depth of 929 feet, or 229 feet below sea level, showing a

*16th Ann. Rep. Geol. Surv., Ind., 1888, 184.

descent of 11 feet in the surface of the Trenton between the two wells. This, alone, was sufficient to show that oil would not be found in that direction south of the river, yet a number of bores were sunk the present season to try to prove the contrary.

A third bore was put down on the John Younce farm near the center of section 21 (26 north, 5 east), Butler Township. The Trenton was found at a depth of 960 feet, but the surface level was not determined, hence the record is of little value. A small quantity of gas was found at 970, and salt water, which filled the bore, at 1,000 feet.

The fourth and last well, until those of 1897, was located on the farm of A. C. Bearss in the southwest quarter of section 16 (27 north, 4 east), about three miles north of the center of Peru. The section at this well was as follows:

Drift	324 feet.
Niagara limestone	379 feet.
Hudson River and Utica shale	307 feet.
Top of Trenton	1010 feet.
Total depth	1041 feet.
Surface above sea level	757 feet.
Top of Trenton below sea level	253 feet.

This showed a decline of 35 feet in the level of the Trenton between wells No. 1 and No. 4, and should have proven the futility of farther boring in this direction.

No farther search was made for gas or oil until the spring of 1897, when 100 citizens of Peru organized the "People's Oil and Gas Company." Ten dollars each was subscribed and a bore put down on the B. E. Wallace farm south of the Wabash and just east of the Mississinewa River. No surface level was taken and no accurate record was kept of the well. No one seems to know the depth at which Trenton was struck, which was on June 29th. The bore proved a dry hole, and the contractor agreeing to drill another for $500, the members of the company put up $5 each and the second well was put down in the northwestern part of Peru, on a triangular piece of ground about one-third mile a little south of west of the first bore put down in 1888. This land belongs to W. N. Dukes, and lies just north of the Wabash Railway in the southeast quarter of section 28 (27 north, 4 east). The surface of this well was about 657 feet above sea level, and the top of the Trenton was reached on July 19th, at 855 feet, or 198 below sea level, showing a rise of 20 feet in one-third mile, providing the measurements were correctly made. Oil was found a few feet in the Trenton, and the well filled to the top and flowed a small but steady stream through the casing, yielding about 12 barrels per day for three

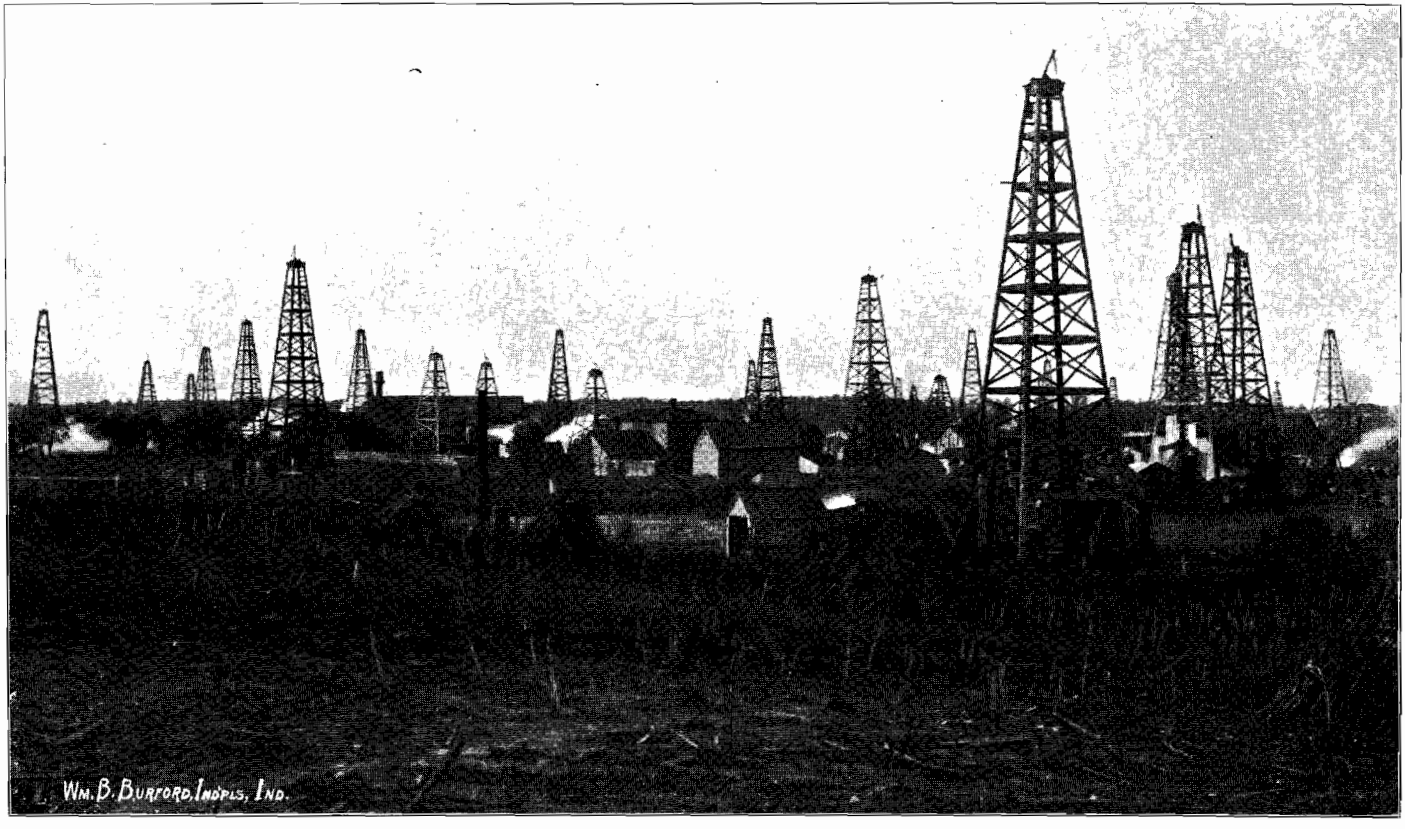
weeks. The well was then tubed and pumped and began yielding 120 barrels a day, which it kept up for a month or more. As this was the first oil ever found in the county it created no little excitement, and the company immediately began the sinking of two more wells on the same 16-acre lease. A number of new companies were organized, one of which, the Runyan Co., began sinking a well 400 feet east of the Dukes No. 1. These three wells were completed about the same date, September 10th.

In the Dukes No. 2, 350 feet southwest of No. 1, Trenton was struck at 844½, and when penetrated but three feet the bore filled with oil and overflowed faster than the product could be taken care of in barrels. The bore was finally sunk 25 feet in Trenton and tubed, and the well began yielding 175 barrels daily. The Dukes, No. 3, found the Trenton at 848½ and was sunk 21 feet deeper. It started at 150 barrels. The Runyan well pierced the Trenton at 859½ feet, and started with a yield of 140 barrels.

The opening of three new wells, each with an excellent yield, started an oil craze which ran riot through the town. Every citizen who could raise five or ten dollars joined an oil company, and most of the land within five miles of the city which could be leased at all was soon under contract. Old oil operators from the main field and from Alexandria flocked to Peru in droves, but found little choice territory unleased. Royalties of as high as one-fourth were asked and given, and it is even claimed that an over-sanguine farmer refused $3,000 bonus and one-third royalty on a farm which was supposed to be near the heart of the field. Some of the newcomers secured the right of way along the Wabash and L. E. & W. railways, and derricks began to go up on all sides of the little triangular tract known as "the Dukes lease."

By the 25th of September more than 30 rigs were up and wells drilling within one-fifth of a mile of the four producing wells. Town lots were leased and square feet, rather than acres, were contracted for. The local operators, who knew little of the oil business, thought that all that was necessary was room enough to set up a rig and a boiler. Fancy prices were paid for town lots, and as the new wells began to come in as fine producers the craze grew apace, and stock which had cost the owners five to twenty dollars sold for $250 to $1,000, with more eager to buy than there were to sell.

Just north of the Dukes lease the surface rises about 50 feet and forms what is known as Hospital Hill. A number of the wells put down in the first half of October were located on this hill east of Dukes street, and all of them came in with handsome yields. The



A PORTION OF HOSPITAL HILL, PERU INDIANA, DECEMBER 1, 1897, SHOWING OIL DERRICKS ON TOWN LOTS.

best of these, and probably the best well in the entire field, was put down by the Crescent Co. on the Artis lot. A record of this well as kept by the superintendent of the company shows the strata pierced to be as follows:

Drift	20 feet.
Niagara limestone	375 feet.
Hudson River shales and limestone	255 feet.
Utica shale	248 feet.
Top of Trenton at	898 feet.
Total depth	933 feet.

This well was drilled in October 22nd, and produced 400 barrels of oil a day for four days. The production then dropped gradually to 100 barrels, which it was making November 12th, when three weeks old. An experienced operator from Findlay, Ohio, concluded that a well on an adjacent lot would produce as much. Normally the lot was worth $200, but he paid $1,500 for it and put down a well which started at 30 barrels daily.

On ten acres of land owned by the Peru Bagging Co., a short distance from the Artis well, six wells were put down which struck the Trenton at an average depth of 902 feet, and had an initial production of about 75 barrels each. The accompanying plate shows a portion of Hospital Hill as it appeared on December 1st, 1897, the bagging mill with its surrounding derricks being just to the left of the center of the view.

North of the Bagging Co.'s plant several fair wells have been drilled on the R. B. Runyan land; but two put down by the Ohio Oil Co. on the Rachael Zern farm, west half of southwest quarter of section 21 (27 north, 4 east), have yielded much salt water and but 20 to 25 barrels of petroleum.

Progress eastward was stopped by two bores, one a small producer, which was soon abandoned, on the E. A. Beares land, about one-third mile east of the People's No. 1 and 500 feet west of the first well drilled in the county in 1888; the other a bore in North Peru (Godfrey Reservation No. 12), which found the Trenton rock at 867 feet, but proved barren.

South of the Wabash Railway, between Grant Street and the Peru Driving Park, a large number of good wells were put down in October and November by the Klondike, Peru and People's oil companies. In this region the Trenton rock was found between 850 and 860 feet, showing its surface to be from 200 to 215 feet below sea level.

South of the Wabash River a number of bores were put down, the location of each being given in the list which follows, not one of which

found more than a mere trace of oil. On the T. Riley farm, just north of the Driving Park, a well which never produced more than ten barrels daily stopped the growth of the field in that direction; while several dry holes farther northwest served to mark more definitely its boundaries.

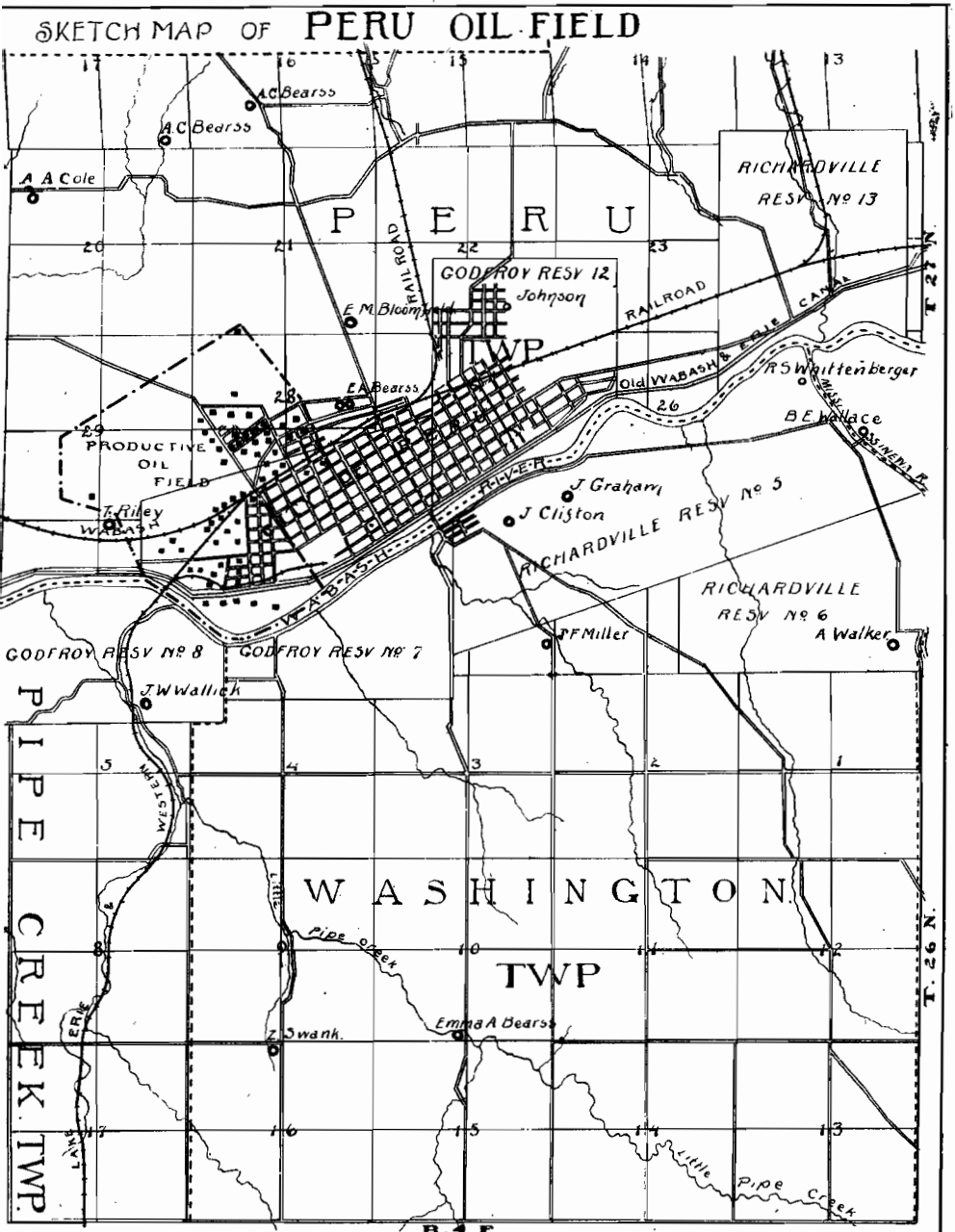
By the first of December the limits of the territory producing oil in paying quantities were fairly well defined, as shown on the accompanying map, and active operations greatly decreased, since all the inside territory was under lease. The number of wells finished in November was 88, 38 more than in October. At the close of the month but 22 wells were being drilled, and in December but 28 were finished, none of which were non-productive.

A list of the dry holes put down in Miami and adjoining counties which served to mark the boundaries of the Peru field is here given.

A LIST OF NON-PRODUCTIVE BORES FOR PETROLEUM IN MIAMI AND ADJOINING COUNTIES.*

Owners of Land.	*Location.*	*Depth to Trenton Limestone.*	*Approximate Depth of Surface of Trenton Below Sea Level.*
1. E. A. Bearss	Southeast quarter of northeast quarter of section 28 (27 north, 4 east), Peru Township	875	218
2. J. F. Miller	Southeast quarter of section 34 (27 north, 4 east), Washington Township	929	229
3. Jno. Younce	Northeast quarter of southwest quarter of section 21 (26 north, 5 east), Butler Township	960	200
4. A. C. Bearss	Southwest quarter of section 16 (27 north, 4 east), Peru Township	1010	253
5. B. E. Wallace	Northwest corner Godfrey Reserve No. 9, Butler Township	? 870	?200
6. E. A. Bearss	500 feet west of No. 1, Peru Township	870	213
7. B. A. Blair	Southeast quarter of southeast quarter of section 19 (27 north, 4 east), Peru Township	884	224
8. E. M. Bloomfield	Southeast quarter of southeast quarter of section 21 (27 north, 4 east), Peru Township	866	206
9. —— Johnson	East part of North Peru, Godfrey Reserve No. 12, Peru Township	867	207
10. A. A. Cole	Northwest quarter of section 20 (27 north, 4 east), Peru Township	870	200
11. Sarah Myers	Southwest quarter of section 18 (27 north, 4 east), Peru Township	920	267

*Much of the data for this list was gathered and kindly furnished for this report by Messrs. Masterman and Chenvront, of Peru.


SKETCH MAP OF PERU OIL FIELD
A C Bearss
A C Bearss
A A Cole
P E R U
TWP
RICHARDVILLE RESV No 13
GODFROY RESV 12
Johnson
E M Bloomfield
RAILROAD
RAILROAD
Old WABASH & ERIE CANAL
R S Waltenberger
B E Wallace
E A Bearss
PRODUCTIVE OIL FIELD
T Riley
J Graham
J Cliston
RICHARDVILLE RESV No 5
RICHARDVILLE RESV No 6
J F Miller
A Walker
GODFROY RESV No 8
GODFROY RESV No 7
J W Wallick
PIPE CREEK TWP.
WASHINGTON TWP
Pipe Creek
Emma A Bearss
Z Swank
Little Pipe Creek
T. 27 N.
T. 26 N.
R. 4 E.
LEGEND:
Productive wells
Dry wells
Limits productive area
Township (civil) lines
GHA Del

12.	A. C. Bearss—Southeast quarter of section 17 (27 north, 4 east), Peru Township	932	285
13.	T. Riley—Just north of Peru Driving Park, Peru Township	875	220
14.	J. W. Wallick—East half of Godfrey Reserve No. 8, Pipe Creek Township	907	252
15.	G. A. Shuman—Northeast quarter Lablonda Reserve, Pipe Creek Township	871	246
16.	J. Graham—Northwest quarter of Richardville Reserve No. 5, Washington Township	902	242
17.	J. Clifton—Northwest quarter of Richardville Reserve No. 5, Washington Township	904	244
18.	Anthony Walker—East half of Richardville Reserve No. 6, Washington Township	983	228
19.	R. S. Whittenberger—Northeast quarter Richardville Reserve No. 5, Washington Township	879	204
20.	C. C. Enswiler—North part of Richardville Reserve No. 5, Washington Township	895	220
21.	Z. Swank—Northeast quarter of northwest quarter of section 16 (26 north, 4 east), Washington Township	1020	265
22.	Emma A. Bearss—Southeast quarter of southwest quarter of section 10 (26 north, 4 east), Washington Township	1006	236
23.	S. Thorn—Santa Fe well, Southeast quarter of section 32 (26 north, 5 east), Butler Township	932	215
24.	—— North half of section 32 (26 north, 4 east), Bunker Hill well, Pipe Creek Township	992	161
25.	Bennett's Station—On L. E. & W. R. R., 15 miles south of Peru	1009	167
26.	—— Williams—One mile south of Waverly, Cass County	982	225
27.	R. R. Depot—Southeast quarter of section 21 (27 north, 3 east), Waverly well No. 1	1000	
28.	—— Davis—Northwest quarter of section 31 (26 north, 3 east), Walton, Cass County	1012	172
29.	J. B. Crook—Near Hoover's Crossing, Cass County	1046	346
30.	N. Stroud—Northeast quarter of section 6 (27 north, 4 east), Mexico well	998	325
31.	———North half of section 16 (28 north, 4 east), Denver well	1004	329
32.	C. C. Mikesell—Southeast quarter section 7 (26 north, 6 east), Waltz Township, Wabash County	945	220
33.	E. J. Williams—One mile south of Keller's Station, Wabash County	879	199
34.	Andrews well—Near Wabash Railway	938	209
35.	Lutz farm—2½ miles north of Wabash, Wabash Co.	1057	284

Up to January 1st, 1898, the only producing wells in the Peru field outside of the area as defined were two in number. One of these was located just north of Keller's or Rich Valley, a station on the

Wabash Railway nine miles east of Peru, and the other on the west side of the village of Walton, Tipton Township, Cass County. The Rich Valley well is on the farm of W. A. Jackson in the southwest quarter of the northwest quarter of section 13 (27 north, 5 east). A record of this well obtained and kindly furnished by Mr. J. E. Chenvront, of Peru, is as follows:

Drive pipe	None.
Casing	450 feet.
Trenton struck at	883 feet.
Total depth	907 feet.
Surface above sea level	675 feet.
Top of Trenton below sea level	208 feet.

Initial production, 35 barrels.

The surface of the Trenton was found at about the same level as in many of the fair producing wells at Peru. In general it may be said that in western Wabash and Miami counties, where the Trenton lies lower than 215 feet below tide, a dry hole or salt-water well will almost invariably result. Whether the Rich Valley strike will develop a pool or an eastward extension of the Peru field only the work of the drill will disclose.

Lying as it does between the western end of the main field and the development at Peru it strengthens the belief that the two are connected. If the connection be not continuous there doubtless exist many small, isolated pools or islands of porous Trenton between the two fields. These islands occupy the sites of lagoons which existed shortly after the time the Trenton was laid down and furnished the conditions favorable for the chemical changes which brought about the porosity of the oil-bearing portions of the Trenton limestone. Therefore, at present the best field for the wild-catter, in the writer's opinion, lies southeast of Rich Valley between that town and Van Buren, Grant County.

The Walton well was sunk on the land of J. Baumgardner, northeast quarter of section 36 (26 north, 2 east), about one-third of a mile west of where a dry hole had been previously drilled.* The Trenton was pierced at 1,011 feet below the surface, and its elevation was therefore about 171 feet below sea level. The drill was sunk 13 feet in Trenton, when the oil rose to within 200 feet of the top of the bore. The well had an initial output of about 35 barrels, and is probably near the outer border of an isolated island of porous rock, or so-called "pool" of petroleum.

*See No. 28 in the table of non-productive bores.

The cost of production in the Peru field is somewhat less than in that of the main Indiana field, especially if the operator owns his own string of tools. The wells are, on an average, 125 feet less in depth. The drift is in general much more shallow and the amount of drive pipe required therefore less. The Niagara limestone is more shelly and broken, and on that account more easily drilled. Between 400 and 425 feet from the surface there is a "break" in the limestone of 20 to 40 feet, which is occupied by a layer of shale. It is customary to case through this break and through eight to fifteen feet of limestone lying below it, which contains a brackish water. The average amount of casing in the Peru field is, therefore, about 450 feet.

The first "pay streak" is found close to the surface of the Trenton, instead of 18 to 30 feet in, as in the main field. In most cases there appears to be but one stratum of porous rock, though in some of the wells where the Trenton is high there are two, the second being about 25 feet in the limestone. In numerous wells there is found below the first pay streak a fine-grained whitish sand, which packs so tightly in the bottom of the bailer that it is difficult to dump. Where two pay streaks are present this sand occupies from two to five feet of the interval between them.

The dolomite or oil-bearing portion of the Trenton is 12 to 20 feet in thickness, darker and much more porous than that in the main field. A piece at hand weighing seven pounds is literally honeycombed with pores plainly visible to the naked eye. It has numerous cavities, the size of a hickory nut or smaller, opening on the surface, which are lined with small rhombohedric crystals of dolomite, so that the cavity resembles, on a small scale, that of the inside of a geode. Intermingled with these crystals are numerous small cubical crystals of pyrites or iron sulphide. These crystals of pyrites are also characteristic of the porous Trenton of the Broad Ripple field, and it is there claimed that only where they occur in numbers is petroleum found in paying quantities.

On account of the porosity of the oil-bearing rock and its proximity to the top of the Trenton but few wells in the Peru field were shot with nitro-glycerine. There was too much danger of shattering the overlying Utica shale and so causing it to fill up the bore into the porous reservoir, or of flooding the well with salt water from the underlying water-bearing portion of the Trenton. A saving of from $75 to $150 in cost was effected by omitting the shooting.

The great porosity of the oil-bearing stratum accounts for the richness of the pool, each pore being simply a small reservoir where a stock of petroleum has been stored for thousands of years. With 200

pumps constantly drawing on this stock within an area of a mile and a half square it is no wonder that the output gradually lessens, and unless the pool is larger than it now seems the stock will soon be exhausted. No gas is found with the oil, and it is forced upward in the bore or to the surface by water pressure alone. As the stock of oil lessens the water is slowly rising and in time will fill the pores and take forever the place of the more valuable fluid.

The oil from the vicinity of Peru is darker and more viscid or sticky, owing to its containing a greater percentage of tarry matter or solid bitumens, than that from the main Indiana field. For this reason it is more difficult to separate from the water and more expensive to handle. Being wholly free from gas, it is heavier and has not the life or sparkle of the eastern oil. Up to the present the price paid for the two has been the same, though that at Peru requires a longer steaming to prepare it for the market and a greater percentage of residue is left in the tanks.

The average cost of the first productive well on a lease in the Peru field in 1897 was about as follows:

Rig	$250.00
Drilling	400.00
Drive pipe	25.00
Casing	125.00
Pumping and tubing	130.00
Two tanks	150.00
Receiving tank	40.00
Engine and boiler for pumping	450.00
Total	$1,570.00

The second well cost $450 less, as the one engine and boiler served to pump both. In many cases, however, the lease consisted of a town lot, where but one well could be put down. Adding to the $1,570 invested, $94, the interest at 6 per cent. for one year, and $480, the wages of a pumper, we have $2,144, the amount necessary to put down and operate a town-lot well for one year.

The average well on December 1st was making but 18 barrels a day, or 15 barrels aside from the royalty. Of this four barrels were used as fuel, leaving 11 barrels for sale, which, at the prevailing price of oil—41 cents—would be $4.51 for the income of the operator. If the well should hold up to an eighteen-barrel output for a year, which there is one chance in a thousand of its doing, the operator would receive, at the prevailing price of oil, $1,646, showing a loss of $498 on his venture. The chances are that in 1898 the town-lot wells will average less than eight barrels each per day and that but few of them

will ever pay out. Where the leases are in tracts of from 20 to 80 acres and four to ten wells have been put down on them some money will doubtless be made. There is room inside of the productive area for but few companies to operate such leases, and for that reason much more money has been sunk in the field than will ever be gotten from it, unless its area is greatly increased. The following statistics of the field, brought up to January the first, 1898, will aid in showing the truth of the last statement:

STATISTICS OF THE PERU OIL FIELD FOR 1897.*

No. of wells drilled	229	
No. of wells producing Jan. 1st 1898	178	
No. of wells abandoned after producing	25	
No. of wells, dry holes	26	
Daily production Jan. 1st, 1898	2,264	barrels.
Average production per well Jan. 1st, 1898	12.7	barrels.

PRODUCTION SOLD.

September	10,257	barrels.
October	55,376	barrels.
November	88,725	barrels.
December	67,918	barrels.
Total	222,276 barrels at 41c	$91,133

APPROXIMATE EXPENDITURES IN THE PERU FIELD.

204 producing wells @ $1,300	$265,200
25 dry holes @ $700	17,500
Bonuses paid for leases	15,000
Capital invested by Buckeye Pipe Line	100,000
Salaries paid 50 pumpers for three months	7,500
Interest on above amount at 6 per cent. for two months.	4,052
Total amount invested Jan. 1st, 1898	$409,252

THE BROAD RIPPLE OIL FIELD.†

During the year 1897 petroleum in commercial quantities was produced from a number of wells in the vicinity of Broad Ripple, Marion County, five miles northwest of Indianapolis. The developments of the year were such that the field promises much for the future and will doubtless be the scene of active operations during 1898.

* This table includes 11 wells located at Bunker Hill, Denver, Fulton, Mexico, Santa Fe, Rich Valley, Walton and Waverly. The production does not include the amount used for fuel or other purposes in the field.

† Much of the data relative to the Broad Ripple field was furnished by Edward Kirkpatrick, of Indianapolis, an experienced operator, who has made a careful study of the conditions within its present bounds.

The first deep bore put down in this field was sunk for gas in the village of Broad Ripple, southwest quarter of section 36 (17 north, 3 east), in 1888. A record of the strata pierced by that bore is as follows:

Drift	55 feet.
Corniferous limestone	48 feet.
Niagara limestone	257 feet.
Hudson River and Utica shale	504 feet.
Top of Trenton	864 feet.
Total depth	888 feet.
Surface of bore above sea level	755 feet.
Top of Trenton below sea level	109 feet.

This bore yielded a small amount of gas and a good showing of oil, but neither in sufficient quantities for commercial use, and as gas was the object sought, no attempt was made to develop the petroleum industry.

Three other bores were put down for gas in the vicinity of Broad Ripple about the same time, one on the Jas. Huffman farm, one-half mile west of the town, northwest quarter of southeast quarter of section 35 (17 north, 3 east), which proved dry; a second in Fairview Park, west half of section 11 (16 north, 3 east), two miles southwest of Broad Ripple, and the third on the Boardman farm, three-quarters of a mile northeast of the town, the last two with a fair showing of oil. As the prospectors were at that time also in search of gas but little attention was paid to the presence of petroleum, and drilling was stopped until March, 1896.

At the latter date Mr. Alex. McKnight, an experienced operator from the Pennsylvania field, learned of the presence of oil in the former bores put down near Broad Ripple, and visiting the vicinity, secured leases on about 3,500 acres of land in Washington Township, west and northwest of the town. In company with W. J. Murphy and other citizens of Indianapolis he organized the Keystone Oil Company, and a bore was started on the Wm. H. Sharp farm in the southwest quarter of the northeast quarter of section 34 (17 north, 3 east), one and a half miles a little north of west of Broad Ripple. The elevation of the surface at this bore is about 60 feet above Broad Ripple, or 810 feet above tide. The following is a record of the well as furnished by Mr. Kirkpatrick:

Drive pipe	90 feet.
Casing	425 feet.
Trenton struck at	930 feet.
Total depth	942 feet.
Top of Trenton below tide	120 feet.

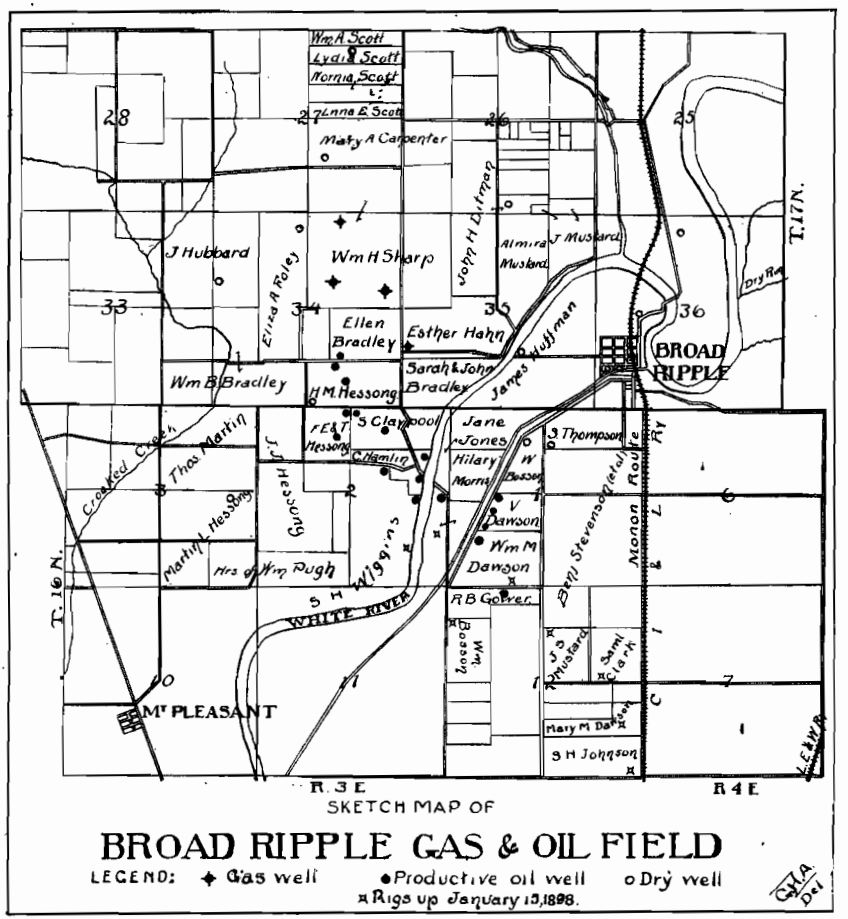
The Trenton was found to be a dark, porous rock and yielded a large amount of gas, the pressure being 315 pounds per square inch and the output estimated at 1,500,000 cubic feet per day. A second bore was put down one mile northwest of Broad Ripple on the Jno. H. Ditman farm, southwest quarter of southeast quarter of section 26 (17 north, 3 east), which proved dry, the Trenton being a close-grained, white, hard rock. Dry holes were also drilled by the same company on the James Hubbard farm, northwest quarter of section 34, and on the Mary A. Carpenter farm, southeast quarter of section 27 (17 north, 3 east), and a second gas well was developed on the W. H. Sharp farm.

In May, 1896, Dr. R. C. Light organized the Broad Ripple Gas Company and secured a lease on the E. A. Foley and H. M. Hessong farms, in section 34, for the purpose of producing natural gas for consumption at Broad Ripple. A bore was sunk on the Foley farm, directly west of the Sharp No. 2 gas well, which developed gas, oil and salt water. The gas was sufficient in quantity to furnish fuel to drill a well on the northwest corner of the Hessong farm. This was finished the latter part of May, 1896, and was the first well producing oil in any quantity in the Broad Ripple field, yielding about 50 barrels the first 24 hours. The owners were, however, seeking gas instead of oil, and though the well was tubed, no pumping attachment was affixed. It continued to flow oil in small quantities, which was barreled on the spot. A second bore in the southwest corner of the Hessong farm resulted in a dry hole, as did also a third on the Scott farm, in the northeast quarter of section 27 (17 north, 3 east). Meanwhile a small oil producer was drilled in by the Keystone Company on the Ellen Bradley farm, just north of the Hessong No. 1. This well was shot once, then drilled deeper and a second shot put in, which in part lodged above the Trenton, and as yet has never been exploded.

The Broad Ripple Company gave up its search for gas and surrendered its leases to the Keystone, after making arrangements with the latter company to furnish gas from the wells on the Sharp farm to consumers at Broad Ripple. The developments of 1896 resulted, therefore, in two small oil wells, three gas wells and six dry holes.

In 1897 no developments were made in the Broad Ripple field until August, when a bore was finished by the White River Company on

the H. M. Hesssong farm about 800 feet southeast of the No. 1 well. When the Trenton was pierced at 929 feet oil began to fill the hole and soon ran over the top, and when the well was shot and put to pumping it yielded 125 barrels per day for a week. In a month the production had dropped to 75 barrels, and by January 1, 1898, was down to 15 barrels.



SKETCH MAP OF

BROAD RIPPLE GAS & OIL FIELD

LEGEND: ✦ Gas well ● Productive oil well o Dry well
✕ Rigs up January 15, 1898.

Several companies now entered the field and scoured the surrounding country for leases, which were hard to obtain, as the White River and Keystone companies had most of the land under contract.

The second bore sunk in 1897 was 1,000 feet southeast of Hessong No. 2, on the Claypool farm. It also started at 125 barrels, but trouble occurred by the caving of the Utica shale, the shot having been too

high, and the production soon dropped to 70, and by January 1st, 1898, to 20 barrels. A second well on the same farm, 700 feet southeast of No. 1, was finished on November 23d, and proved the best producer drilled in 1897, flowing 150 barrels per day for ten days, and on January 1st was pumping 50 barrels.

The Ohio Oil Company (an adjunct of the Standard) secured a lease and put down two wells on the F. E. & T. Hessong farm, east half of northwest quarter of section 2 (16 north, 3 east), just west of Claypool's. One of these was drilled 80 feet into the Trenton and shot with 200 quarts of nitro-glycerine. It started at 90 barrels; the other, 700 feet south and 100 west, was a very light well, and is yielding at present but five barrels daily.

At "Crow's Nest," near the bridge across White River, one mile southwest of Broad Ripple and nearly one mile southeast of H. M. Hessong No. 1, two wells were drilled on the Hamlin farm, one of which started at 40 and the other at 100 barrels daily. Forty rods south of the wagon bridge, on the west side of White River, is the No. 2 well on the Wiggins farm. In it Trenton was struck at 850 feet, and the bore filled to within 50 feet of the surface before being shot. After shooting it began to yield 150 barrels daily, and is probably the second best well in the field. The Wiggins No. 1, 1,500 feet northwest on the same farm, is a light producer, yielding about eight barrels on January 1st. A dry hole was sunk by the Ohio Oil Company on the M. L. Hessong farm, in the northeast quarter of the southeast quarter of section 3 (16 north, 3 east), which is one-half mile farther southwest than any other bore in the field. The Trenton was found 15 feet lower than on the E. & T. Hessong farm, and was pierced 207 feet. Between 170 and 190 feet in Trenton the rock became dark and porous, but yielded blue lick water instead of gas or oil.

East of White River are two producing wells, one on the M. Garver farm, close to the east line of section 2, and the other one-third of a mile northeast on the V. Dawson farm. These are the most southeasterly wells in the field, and started at about 40 barrels each.

Two dry holes were drilled in Broad Ripple in November, the Trenton being struck at 850 and pierced to a depth of 40 feet. Bores which produced only a showing of oil were also put down on the Wm. Bosson and S. Thompson farms on the line between Broad Ripple and the V. Dawson well.

The statistics of the Broad Ripple field from March, 1896, to January, 1898, are as follows:

STATISTICS OF THE BROAD RIPPLE OIL FIELD TO JANUARY 1, 1898.

Total number of bores	29
Bores producing oil in commercial quantities	12
Bores producing gas in commercial quantities	4
Dry holes	13
Wells drilling	4
Total daily production Jan. 1st, 1898	230 barrels.
Average production per well, Jan. 1st, 1898	19 barrels.

PRODUCTION OF THE BROAD RIPPLE FIELD BY MONTHS IN 1897.*

August	188 barrels.
September	1,886 barrels.
October	1,070 barrels.
November	1,660 barrels.
December	2,892 barrels.
Total	7,696 barrels.

The productive oil wells are found in a strip of territory three-fourths of a mile wide and a mile and a half long, extending in a northwest and southeast direction from the Bradley farm, in the southeast quarter of section 34 (17 north, 3 east) to the V. Dawson farm in the northeast quarter of the southwest quarter of section 1 (16 north, 3 east). The porous oil-bearing stratum lies very near the top of the Trenton, and in the productive wells is found from 10 to 15 feet higher than in the non-productive bores to the northeast and southwest. Salt water in quantity has not been found in any of the wells yet drilled, either productive or dry. The flow of gas in large amounts from some of the wells bored would indicate the presence of a good-sized area of oil-producing territory in the immediate vicinity of the field as developed. There are no indications as yet to prove that the Broad Ripple oil field is connected with the main oil field in Grant and Blackford counties. As already noted, oil is liable to be found in commercial quantities in isolated areas anywhere within 15 to 25 miles of the margins of the main gas field, and will eventually be found over the greater portion of that field. The Broad Ripple field lies on the southwestern slope of the gas field within the distance named. It is most probably an isolated area of porous Trenton rock, formed in the manner previously mentioned†, and its area can only be circumscribed by the future use of the drill. Since wells with a showing of oil have, in the past, been drilled at the Atlas Engine Works, within the limits of Indianapolis; at Brightwood, in section 29 (16 north, 4 east); on the Mary J. Wolf farm, in the northeast quarter

* Not including the amount used for fuel and other purposes in the field.

† See p. 156 of the present volume.

of the southeast quarter of section 21 (16 north, 4 east), and on the Hezekial Smart farm in the northeast quarter of section 6 (16 north, 5 east), two miles northeast of the station of Lawrence, the field may expand into one of large size. At any rate, it at present offers good attractions to the speculative operator, and it is to be hoped that the season of 1898 will bring him a fair degree of success.

* * *

Up to the present, much more money has been put into the Indiana oil field than has been gotten from it. The reason for this lies with the operators themselves, and not with the field. They come in from other States and lease a large amount of territory, which they fail to properly develop. They expect to get rich from the leases and not from the oil which they develop from them. If, within the productive area of each of the fields, a well had been sunk on every eight acres, and those on each lease of 40 to 160 acres connected with one power, and then managed as other successful business interests are managed, the success would have been much greater, and the balance on the ledger of the Indiana field would have been on the opposite side from where it is at present. There is no doubt but that the oil is there, but different methods of development will have to be inaugurated before the field becomes as productive, proportionally, as those of Ohio, Pennsylvania and West Virginia.